Claims:

1. A direct digitally controlled microwave tuning element, comprising:

a microwave circuit that is being tuned to a predetermined microwave frequency;

an electrically tunable element for tuning the microwave circuit to the predetermined microwave frequency, the electrically tunable element being attached to a substrate and further comprising a plurality of tuning signals, means for noise filtering said tuning signals to generate noise filtered tuning signals, a converter, based on the noise filtered tuning signals, that controls the frequency of the microwave circuit to a predetermined microwave frequency and an analog tuning signal that is integrated into the substrate and mounted on said noise filtering means.

2. The element of Claim 1, wherein the converter further comprises a digital to analog converter that changes a predetermined characteristic in response to the noise filtered digital signals so that the microwave circuit tunes itself to a microwave frequency based on the digital signals.

3. The element of Claim 1, wherein said tuning signals comprise one or more digital signals for effecting the coarsely tuning of the microwave circuit and at least one analog tuning signal for effecting the fine tuning of the microwave circuit.

4. The element of Claim 3, wherein said converter comprises a capacitor including at least one moving capacitor plate and two or more sub-plates electrically isolated at DC or low frequencies from each other and from the moving plate for electrically controlling the deflection of the moving plate based on the tuning signals.

5. The element of Claim 4, wherein the tuning signals are connected to the sub-plates of the capacitor and wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having predetermined area such that the capacitance change of the capacitor based on the first sub-plate is approximately ½ of the total capacitance of the capacitor and a second sub-plate having a second predetermined area so that the change in the capacitance of the capacitor based on the second sub-plate is approximately ½ the change caused by the first sub-plate to create a binary weighting of the sub-plates so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

6. The element of Claim 4, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having an area such that the capacitance of the capacitor is approximately ½ of the total capacitance of the capacitor and a second sub-plate having an area equal to approximately ½ of the area of first sub-plate so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

7. The element of Claim 5, wherein the area of each sub-plate is decreased by decreasing the width of the each sub-plate.

8. The element of Claim 7, wherein the area of a sub-plate having a width too small to manufacture is decreased by changing the length of the sub-plate.

9. The element of Claim 4, wherein the dimensions of each of said sub-plates that is driven by each of said tuning signals are set to represent a predetermined, substantially additive, binary weight of a desired tuning effect effect caused by the moving plate.

10. The element of Claim 4, wherein the moving plate of the capacitor comprises a cantilevered beam and wherein said sub-plates are arranged in parallel to said cantilevered beam attached to the substrate.

11. The element of Claim 4, wherein the moving plate of the capacitor further comprises a cantilevered beam and wherein said sub-plates are arranged perpendicular to said cantilevered beam on the substrate.

12. The element of Claim 4, wherein the moving plate of the capacitor further comprises an interdigital cantilevered beam and wherein said sub-plates are static interdigital beams divided in parallel to said moving cantilevered beam.

13. The element of Claim 4 wherein the moving plate of the capacitor further comprises an interdigital cantilevered beam and wherein said sub-plates are static interdigital beams divided perpendicularly to said moving digital beam.

14. The element of Claims 2, wherein said digital to analog converter further comprises one or more resistors in a resistor ladder wherein at least some of the resistors are located inside of a noise shield and some of the resistors are located outside of the noise shield, wherein the resistors inside and outside of the noise shield are connected together by a noise rejection bypass capacitor that is integrated into the noise shield.

15. A direct digitally controlled element for tuning to a microwave frequency, the element comprising:

means for generating one or more digital signals;

means for noise isolating the one or more digital signals in order to reduce the noise contained in the one or more digital signals; and

means for controlling a device using the noise isolated digital binary signals, the device changing a predetermined characteristic in response to the digital signals so that the device tunes itself to a microwave frequency based on the digital signals, the device comprising two or more elements that change the predetermined characteristic when charged by the digital binary signals.

16. A direct digitally controlled capacitor for tuning a circuit to a microwave frequency, the capacitor comprising:

a control plate that deflects in response to a second plate being charged;

the second plate comprising two or more sub-plates electrically isolated at DC or low frequencies from each other and from said moving plate, the sub-plates controlling the deflection of the moving plate in order to change the microwave frequency output from the capacitor; and

a plurality of tuning signals attached to the sub-plates of the capacitor for controlling the capacitor.

17. The capacitor of Claim 16, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having predetermined area such that the

capacitance change of the capacitor based on the first sub-plate is approximately ½ of the total capacitance of the capacitor and a second sub-plate having a second predetermined area so that the change in the capacitance of the capacitor based on the second sub-plate is approximately ½ the change caused by the first sub-plate to create a binary weighting of the sub-plates so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

18. The capacitor of Claim 16, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having an area such that the capacitance of the capacitor is approximately ½ of the total capacitance of the capacitor and a second sub-plate having an area equal to approximately ½ of the area of first sub-plate so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

19. The capacitor of Claim 16, wherein the dimensions of each of said sub-plates that is driven by each of said tuning signals are set to represent a predetermined, substantially additive, binary weight of a desired tuning effect ~~effect~~ caused by the moving plate.

20. The capacitor of Claim 19, wherein the area of each sub-plate is decreased by decreasing the width of the each sub-plate.

21. The capacitor of Claim 20, wherein the area of a sub-plate having a width too small to manufacture is decreased by changing the length of the sub-plate.

22. The capacitor of Claim 16, wherein the moving plate of the capacitor comprises a cantilevered beam and wherein said sub-plates are arranged in parallel to said cantilevered beam attached to the substrate.

23. The capacitor of Claim 16, wherein the moving plate of the capacitor further comprises a cantilevered beam and wherein said sub-plates are arranged perpendicular to said cantilevered beam on the substrate.

24. The capacitor of Claim 16, wherein the moving plate of the capacitor further comprises an interdigital cantilevered beam and wherein said sub-plates are static interdigital beams divided in parallel to said moving cantilevered beam.

25. The capacitor of Claim 16, wherein the moving plate of the capacitor further comprises an interdigital cantilevered beam and wherein said sub-plates are static interdigital beams divided perpendicularly to said moving digital beam.

26. A digital microwave transceiver, comprising:

means for receiving a signal to be transmitted using a microwave frequency; and

means for upconverting the signal onto a predetermined microwave frequency, the upconverting subsystem includes one or more direct digitally tuned circuits for tuning the transceiver.

27. The transceiver of Claim 26, wherein the digitally tuned circuits comprise a direct digitally tunable filter.

28. The transceiver of Claim 26, wherein the digitally tuned circuits comprise a direct digitally tunable diplexer.

29. The transceiver of Claim 26, wherein the digitally tuned circuits comprise a direct digitally controlled oscillator.

30. The transceiver of Claim 26, wherein each digitally tuned circuit comprises a microwave circuit that is being tuned to a predetermined microwave frequency, an electrically tunable element for tuning the microwave circuit to the predetermined microwave frequency, the electrically tunable element being attached to a substrate and further comprising a plurality of tuning signals, means for noise filtering said tuning signals to generate noise filtered tuning signals, a converter, based on the noise filtered tuning signals, that controls the frequency of the microwave circuit to a predetermined microwave frequency and an analog tuning signal that is integrated into the substrate and mounted on said noise filtering means.

31. The transceiver of Claim 30, wherein the converter further comprises a digital to analog converter that changes a predetermined characteristic in response to the noise filtered digital signals so that the microwave circuit tunes itself to a microwave frequency based on the digital signals.

32. The transceiver of Claim 30, wherein said tuning signals comprise one or more digital signals for effecting the coarsely tuning of the microwave circuit and at least one analog tuning signal for effecting the fine tuning of the microwave circuit.

33. The transceiver of Claim 30, wherein said converter comprises a capacitor including at least one moving capacitor plate and two or more sub-plates electrically isolated at DC or low frequencies from each other and from the moving plate for electrically controlling the deflection of the moving plate based on the tuning signals.

34. The transceiver of Claim 29, wherein the tuning signals are connected to the sub-plates of the capacitor and wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having predetermined area such that the capacitance change of the capacitor based on the first sub-plate is approximately ½ of the total capacitance of the capacitor and a second sub-plate having a second predetermined area so that the change in the capacitance of the capacitor based on the second sub-plate is approximately ½ the change caused by the first sub-plate to create a binary weighting of the sub-plates so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

35. The transceiver of Claim 29, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having an area such that the capacitance of the capacitor is approximately ½ of the total capacitance of the capacitor and a second sub-plate having an area equal to approximately ½ of the area of first sub-plate so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

36. The transceiver of Claim 29, wherein said digital to analog converter further comprises one or more resistors in a resistor ladder wherein at least some of the resistors are

located inside of a noise shield and some of the resistors are located outside of the noise shield, wherein the resistors inside and outside of the noise shield are connected together by a noise rejection bypass capacitor that is integrated into the noise shield.

37. A method for determining the sub-plates areas of two or more sub-plates in a tuning device, comprising:

positioning a first sub-plate of a largest weight-effect in a predetermined location;

adjusting the dimensions of said first sub-plate until the desired weight-effect associated with said sub-plate is achieved;

positioning a second sub-plate of a smaller weight-effect adjacent the first sub-plate; and

adjusting the dimensions of the second sub-plate until the desired weight-effect associated with said second sub-plate is achieved.

38. The method of Claim 37 further comprising positioning and adjusting one or more additional sub-plates having one or more smaller weight-effects.

39. The method of claim 37, wherein the sub-plate corresponding to the larger weight-effect are maintained at full length and the weight-effect is changed by changing the width of the sub-plate and wherein the sub-plates whose desired weight-effects are not attainable at the minimum design width are adjusted by shortening their lengths.

40. A direct digitally controlled oscillator, comprising:

a tunable oscillator circuit; and

a direct digitally tuned circuit connected to the oscillator circuit for controlling the frequency of the oscillator circuit.

41. The oscillator of Claim 40, wherein each digitally tuned circuit comprises a microwave circuit that is being tuned to a predetermined microwave frequency, an electrically tunable element for tuning the microwave circuit to the predetermined microwave frequency, the electrically tunable element being attached to a substrate and further comprising a plurality of tuning signals, means for noise filtering said tuning signals to generate noise filtered tuning signals, a converter, based on the noise filtered tuning signals, that controls the frequency of the microwave circuit to a predetermined microwave frequency and an analog tuning signal that is integrated into the substrate and mounted on said noise filtering means.

42. The oscillator of Claim 41, wherein the converter further comprises a digital to analog converter that changes a predetermined characteristic in response to the noise filtered digital signals so that the microwave circuit tunes itself to a microwave frequency based on the digital signals.

43. The oscillator of Claim 41, wherein said tuning signals comprise one or more digital signals for effecting the coarsely tuning of the microwave circuit and at least one analog tuning signal for effecting the fine tuning of the microwave circuit.

44. The oscillator of Claim 41, wherein said converter comprises a capacitor including at least one moving capacitor plate and two or more sub-plates electrically isolated at DC or low frequencies from each other, from the moving plate and from said noise isolating means for electrically controlling the deflection of the moving plate based on the tuning signals.

45 The oscillator of Claim 44, wherein the tuning signals are connected to the sub-plates of the capacitor and wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having predetermined area such that the capacitance change of the capacitor based on the first sub-plate is approximately ½ of the total capacitance of the capacitor and a second sub-plate having a second predetermined area so that the change in the capacitance of the capacitor based on the second sub-plate is approximately ½ the change caused by the first sub-plate to create a binary weighting of the sub-plates so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

46. The oscillator of Claim 44, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having an area such that the capacitance of the capacitor is approximately ½ of the total capacitance of the capacitor and a second sub-plate having an area equal to approximately ½ of the area of first sub-plate so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

47. The oscillator of Claim 44, wherein said digital to analog converter further comprises one or more resistors in a resistor ladder wherein at least some of the resistors are located inside of a noise shield and some of the resistors are located outside of the noise shield, wherein the resistors inside and outside of the noise shield are connected together by a noise rejection bypass capacitor that is integrated into the noise shield.

48. A direct digitally tunable filter, comprising:

at least one resonator element; and

at least one direct digitally tuned circuit electrically coupled to said resonator to control the frequency of the resonator.

49. The filter of Claim 48, wherein each digitally tuned circuit comprises a microwave circuit that is being tuned to a predetermined microwave frequency, an electrically tunable element for tuning the microwave circuit to the predetermined microwave frequency, the electrically tunable element being attached to a substrate and further comprising a plurality of tuning signals, means for noise filtering said tuning signals to generate noise filtered tuning signals, a converter, based on the noise filtered tuning signals, that controls the frequency of the microwave circuit to a predetermined microwave frequency and an analog tuning signal that is integrated into the substrate and mounted on said noise filtering means.

50. The filter of Claim 49, wherein the converter further comprises a digital to analog converter that changes a predetermined characteristic in response to the noise filtered digital signals so that the microwave circuit tunes itself to a microwave frequency based on the digital signals.

51. The filter of Claim 49, wherein said tuning signals comprise one or more digital signals for effecting the coarsely tuning of the microwave circuit and at least one analog tuning signal for effecting the fine tuning of the microwave circuit.

52. The filter of Claim 49, wherein said converter comprises a capacitor including at least one moving capacitor plate and two or more sub-plates electrically isolated at DC or low

frequencies from each other and from the moving plate for electrically controlling the deflection of the moving plate based on the tuning signals.

53. The filter of Claim 52, wherein the tuning signals are connected to the sub-plates of the capacitor and wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having predetermined area such that the capacitance change of the capacitor based on the first sub-plate is approximately ½ of the total capacitance of the capacitor and a second sub-plate having a second predetermined area so that the change in the capacitance of the capacitor based on the second sub-plate is approximately ½ the change caused by the first sub-plate to create a binary weighting of the sub-plates so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

54. The filter of Claim 52, wherein the sub-plates of the capacitor further comprises two or more sub-plates, a first sub-plate having an area such that the capacitance of the capacitor is approximately ½ of the total capacitance of the capacitor and a second sub-plate having an area equal to approximately ½ of the area of first sub-plate so that when one or more of the sub-plates are charged, the control plate deflects a predetermined amount to change the capacitance of the capacitor and tune the microwave device attached to the capacitor.

55. The filter of Claim 52, wherein said digital to analog converter further comprises one or more resistors in a resistor ladder wherein at least some of the resistors are located inside of a noise shield and some of the resistors are located outside of the noise shield, wherein the

resistors inside and outside of the noise shield are connected together by a noise rejection bypass capacitor that is integrated into the noise shield.

56. A method for tuning a microwave circuit to a predetermined frequency using a direct digitally tunable element controlled by one or more coarse tuning digital signals and an analog fine tuning signal, the method comprising:

adjusting the coarse digital signals controlling the direct digitally tunable element so that the output frequency of the microwave circuit to a first value that is approximately equal to the predetermined frequency; and

adjusting the analog fine tuning signal controlling the direct digitally tunable element to adjust the frequency of the microwave circuit from the first value to a final locked frequency.